

Amid the turmoil of conflicting ideas in which we live . . . there seems to be one proposition commanding nearly universal assent: The control man has secured over nature has far outrun his control over himself.
Ernest Jones, *The Life and Work of Sigmund Freud* (1953)

HAZARDOUS WASTE

Perchlorate Debate Grows

The presence of a rocket-fuel component called perchlorate in drinking water sources around the nation has drawn the attention of scientists and public health advocates who say that even small doses of the chemical threaten people's health. But the prospect of billions of dollars' worth of cleanup bills landing on desks in the Pentagon and private industry has created a controversy that the National Academy of Sciences (NAS) has been called upon to help sort out.

The Department of Defense (DOD) and the National Aeronautics and Space Administration have been adding perchlorate to rocket fuel and munitions since the 1940s, and its use remains unregulated. Gina Solomon, a senior scientist at the Natural Resources Defense Council, points out that there is broad agreement that perchlorate interferes with the uptake of iodine into the thyroid gland as well as other tissues, including the placenta and mammary glands. The real danger of perchlorate-contaminated water, Solomon says, is the threat it poses to pregnant women, infants, and fetuses. Whereas adults have the reserve capacity to withstand a month or more with limited iodine intake, a fetus or infant can be harmed much more rapidly due to the reliance of the developing brain on adequate thyroid hormone levels.

The U.S. Environmental Protection Agency (EPA) started measuring for perchlorate as far back as the 1980s, but it wasn't until the 1997 development of a new method to measure concentrations as low as 4 parts per billion (ppb) that the EPA and state environmental agencies were able to initiate serious examinations of the extent of perchlorate contamination of groundwater. According to the EPA, perchlorate had been detected in the groundwater of 33 states as of April 2004, and chemical users and manufacturers have been identified in more than 40.

In 1995, the EPA issued an interim guidance level of 4–18 ppb for perchlorate based on the limited data available at the time. Then, in 1998, the agency issued a draft

health assessment based on studies submitted as part of a joint government testing strategy, and proposed a reference dose of 32 ppb. The external peer review that followed resulted in a recommendation for further testing.

When the EPA issued a revised risk assessment in 2002, it made things potentially much more onerous for the DOD and perchlorate manufacturers by suggesting a drinking water standard of 1 ppb or lower would be necessary to protect public health. In contrast, the Perchlorate Study Group, an industry consortium that has worked with the EPA and the DOD, proposed a much looser reference dose equivalent to 200 ppb.

With interested parties so far apart on their desired perchlorate limits, the Bush administration stepped in and called for the NAS to convene a panel to study the issue. A final report, which the EPA will consider as it finalizes its health assessment, is expected by the end of this year. In the meantime, the EPA is operating under the standing interim health guidance level of 4–18 ppb.

Marianne Lamont Horinko, the agency's assistant administrator for the Office of Solid Waste and Emergency Response, encouraged agency personnel in a 22 January 2003 memorandum to "carefully consider the low end" of that range.

A spokesman for the Perchlorate Study Group, Bill Romanelli, declined to comment on that group's proposed reference dose while the NAS study is still ongoing. But he did say that group representatives had, in a 24 May 2004 meeting with the NAS panel, presented recent unpublished research that preliminarily concluded that a perchlorate level of 110 ppb had no effect on pregnant women and infants, and that levels as high as 10,000 ppb had no effect on healthy adults.

Even as the NAS study goes on, debate swirls. In a 14 May 2004 letter to NAS president Bruce Alberts, California senators Barbara Boxer and Dianne Feinstein questioned the appointment of panelists Richard Bull and Charles Capen, charging that defense contractor Lockheed Martin had funded both scientists in the past.

Some states are taking matters into their own hands. On 11 March 2004 the California EPA announced a goal of 6 ppb perchlorate in drinking water. The next step will be to establish an enforceable standard, which could take another year. Two months later, the Massachusetts Department of Environmental Protection proposed a cleanup guidance concentration of 1 ppb to address contamination in that state's water.

Meanwhile, the perchlorate issue took another turn when the Environmental Working Group, a research and advocacy organization, conducted a study confirming earlier reports of perchlorate in some California-grown lettuce. Renée Sharp, an analyst with that group, points out that the Colorado River, which is polluted by perchlorate, irrigates 1.5 million acres in Arizona and Southern California, and the food grown there is shipped all over the country. "The whole food uptake issue makes it a much more widespread problem than if it was just a drinking water problem," she says. "The drinking water problem itself is pretty enormous, but the food makes it even bigger." —Richard Dahl



Rocket science. The debate is heating up over how much of the rocket fuel additive perchlorate is acceptable in the environment—and how to clean up what's not.

CHILDREN'S HEALTH

Breastfeeding and Babies' Lives

Although infant mortality is low in the United States, recently published research suggests it could be still lower if more mothers breastfed their babies. The study, conducted by NIEHS epidemiologists Aimin Chen and Walter Rogan and published in the May 2004 issue of *Pediatrics*, also indicates that prolonged breastfeeding may foster an even greater reduction in infant mortality.

The researchers drew data from the 1988 National Maternal and Infant Health Survey for their case-control study of breastfeeding and its relationship with infant survival. The survey, conducted by the Centers for Disease

Breast milk is important, but it may be simply part of a parenting package that is overall child-protective. Causality is hard to ascertain; there are many different factors that go into breastfeeding."

Jacqueline Wolf, an associate professor of social medicine at Ohio University in Athens, agrees: "I think what the researchers propose is that very possibly breastfeeding mothers are more in tune with their babies, spend more time with them, and watch them more closely. Other researchers have suggested that the hormones prolactin and oxytocin, associated with lactation, might be responsible in part for more attentive parenting. It's hard to untangle cause and effect here."

According to Wight and Wolf, the relationship between breastfeeding and infant mortality might have been clearer if Chen and Rogan had been able to work with more



Enduring benefits of breastfeeding. New research shows that breastfed babies enjoy greater protection against early death.

Control and Prevention, provided information about breastfeeding and other variables for 1,204 infants who died at age 1–12 months of causes other than birth defects or cancer, and 7,740 infants who survived at least 1 year.

According to Chen and Rogan's analysis, breastfed babies were 21% less likely to die between ages 1 month and 1 year, and those breastfed at least 3 months had a 38% reduction in mortality by age 1. Breastfeeding appeared to reduce mortality regardless of cause of death—infection, injury, sudden infant death syndrome, or other/unknown causes. Interestingly, traumatic injury-related deaths appeared to be the most reduced by breastfeeding, with a 41% reduction.

"[Fewer] traumatic injury deaths was very interesting to me," says Nancy Wight, a neonatologist and medical director of lactation services at Sharp Mary Birch Hospital for Women and Children's Hospital in San Diego. "That was something that I hadn't really thought of before, but it makes sense.

detailed breastfeeding data. "If they had been able to study the effect of breastfeeding exclusivity and duration, and not just initiation rates, my educated guess is that they would have seen even greater correlation between amount of breastfeeding and reduction in infant mortality," says Wolf.

Nevertheless, both Wolf and Wight view this study as a valuable addition to the case for breastfeeding. "It simply reinforces what mothers have known for thousands of years: breastfed babies survive," says Wight.

Wight also indicates that the study serves as a reaffirmation of the need for breastfeeding in an industrialized society. "A lot of physicians and others say [breastfeeding] is fine for the Third World, where they have very high risk of infection and infant mortality anyway, but in the United States we have good formulas, a clean environment, and good health care, and it doesn't make a difference," she says. "This shows very clearly that [breastfeeding] does make a difference." —**Julia R. Barrett**

World Wide Wet

Two major entities have launched efforts to improve water safety in regions around the world. On 22 March 2004, World Water Day, the European Union announced it would set up a €500 million Water Facility to promote access to clean water and sanitation in Africa, the Caribbean, and the Pacific. The facility will involve countries in developing national water policies and offer loans to build basic infrastructure.

To help ensure safe drinking water in Haiti, Pakistan, and Sudan, USAID and four other public and private organizations announced the \$5 million Safe Drinking Water Alliance on 27 April 2004. The project will use an innovative coagulation/flocculation/disinfection water treatment system in its field work, which will focus on educational and marketing approaches to ensure that the new treatment systems get to those who need them the most.



Hydrogen Boost

Secretary of Energy Spencer Abraham announced on 27 April 2004 the first grants under a \$1.2 million White House plan to fund translational research and development of hydrogen fuel technology. This first \$350 million in grants will go toward studies in hydrogen storage, vehicle and infrastructure demonstrations and validation, fuel cell cost and durability research, and hydrogen education for schoolchildren.

Said Abraham at the Detroit press conference announcing the awards, "A hydrogen economy has the long-term potential to deliver greater energy independence by reducing America's dependence on foreign sources of energy." He added that hydrogen "offers immense environmental benefits that current energy technologies cannot meet."

Asian Dust Storm Surge

Statistics in UNEP's *Global Environment Outlook Yearbook 2003*, released in March 2004, attest that thanks to desertification, dust and sand storms are affecting Northeast Asia nearly five times as often as they did in the 1950s, and the storms are growing in intensity. At a UNEP meeting in conjunction with the yearbook's release, Korean scientists said they are concerned that the sand and dust being transported by the storms is binding with other pollutants such as soot.

UNEP executive director Klaus Töpfer said the agency would, with the help of other organizations, set up a network of monitoring stations to standardize data collection, foster data sharing, and build early warning capacity. UNEP is also helping to develop a regional plan for alleviating Asian sand and dust storms.



AGING

Shedding Light on Vitamin D Deficiency in Women

Falls are the largest cause of injury mortality among the elderly. More than a third of U.S. people 65 or over will fall each year, with many fracturing a hip, spine, or forearm. These fractures seriously weaken 20–30% of those who experience them, according to the Centers for Disease Control and Prevention (CDC), as well as kick off a cascade of direct costs, including hospitalization, rehabilitation, nursing home stays, and equipment. The CDC estimates that such costs will rise with the growing senior population, reaching more than \$43 billion by 2020. Recent research on fall injuries in the elderly suggests that vitamin D supplementation could help prevent some of these falls and fractures.

A number of factors linked to elders' risk of falling—cognitive impairment, poor balance, and injuries to the legs—are difficult to improve. But depletion of vitamin D stores is easily remedied to improve safety and lessen the number of falls.

Vitamin D status depends mainly on eating foods containing the nutrient and ultraviolet light–induced vitamin D synthesis in the skin. “As older people become more frail and disabled,” says Leon Flicker,

a medical professor at the University of Western Australia, “they do not go out as much, and are more likely to suffer from vitamin D deficiency.” If they go into assisted living, levels drop further.

Flicker was lead author of a November 2003 *Journal of the American Geriatrics Society* study of fall injuries in elderly Australian women in care facilities. He found that 22% of all the women in his study and 45% of the bed-bound women were vitamin D deficient. But adding back dietary vitamin D can reduce their peril. “We would argue that vitamin D supplementation, with calcium, may decrease the risk of falling and make the bone stronger,” says Flicker.

“The most exciting thing to realize about vitamin D,” says Heike Bischoff-Ferrari, a nutrition researcher at Harvard's Brigham and Women's Hospital, “is that this really is the only thing at hand at this point that both reduces the risk of falling and reduces the risk of fractures in older individuals.” Vitamin D–enhanced muscle tone or cognition may play a role in reducing falls themselves. Plus, vitamin D is well tolerated and inexpensive. A team led by Bischoff-Ferrari published a 28 April 2004 meta-analysis of the effects of vitamin D on falling in *JAMA*.

Given concerns about skin cancer and limited sunlight exposure in certain latitudes, the safest source of vitamin D is dietary supplements. Bischoff-Ferrari and colleagues estimate at least 800 international units of vitamin D may be needed daily to achieve fall prevention in older persons. —**Victoria McGovern**



A supplement to sunshine. Increasing vitamin D consumption can reduce the risk of both falls and fractures in older adults.

NEUROLOGY

Pesticides and Parkinson Disease

In support of the theory that the most common form of Parkinson disease (PD) may result to some degree from exposure to environmental toxicants, researchers at Emory University have identified a mechanism of toxicity linking the pesticide rotenone to the same kind of cell damage that is associated with PD. Experiments in both cell culture and rats demonstrated that the insecticide, derived from natural compounds and often used in organic gardening and farming, reproduced many of the pathological features of PD, including progressive damage to neurons in the brain's basal ganglia that are vital to transmission of dopamine.

In the November 2003 *Journal of Neuroscience*, Emory researchers Tim Greenamyre and Todd Sherer report that rotenone does its damage within the neuron's mitochondria by inhibiting a crucial enzyme in the electron transport chain known as complex I. Chronic treatment with low concentrations of rotenone inhibited complex I, leading to

oxidative stress and gradual degeneration of dopamine neurons in rats, followed by a buildup of protein inside the nerve cells like that known to occur in certain PD patients. The rats also demonstrated an associated movement disorder.

The researchers then examined synthetic pesticides that are used in much greater quantities than rotenone, and that are also known to disrupt complex I in mitochondria. In findings reported at the November 2003 annual meeting of the Society for Neuroscience, they found that pyridaben, used to control mites on fruits and vegetables, was far more toxic than rotenone. “In a human neuroblastoma cell culture, pyridaben did the same thing as rotenone, but much more potently,” says Greenamyre. Pyridaben has not yet been tested *in vivo*.

The researchers cannot yet say whether the new findings should prompt concern about chronic exposure to these chemicals. But what the work does do is show that the way these pesticides affect dopaminergic neurons mirrors what happens when genes go awry. A handful of rare mutations associated with PD have been discovered that appear to affect neurons in the same way,

Greenamyre says: “The diverse causes of Parkinson's disease may all be related mechanistically—that is, by oxidative damage, protein mishandling, and mitochondrial impairment.”

According to University of Pittsburgh scientist Teresa Hastings, some epidemiological data suggest that some people may be at increased risk due to pesticide exposure. However, she says, it's much more likely that increased risk arises through a combination of level and route of exposure and genetic susceptibility.

J. William Langston, founder of The Parkinson's Institute and one of the field's pioneers, agrees. “A lot of people are likely exposed to these pesticides, but few develop Parkinson's disease, so [this research] suggests that those who do develop it have genetic predilections,” he says.

Finding common mechanisms between rare forms of the disease and environmental chemical exposures may offer a bit of good news, Greenamyre says. “If you can define a common pathway that leads to neurodegeneration in Parkinson's disease,” he says, “it may be possible to design drugs that protect that pathway.” —**Renée Twombly**

ehpnet

Special Programme for Food Security

At the same time that developed countries—where an abundant stream of cheap and easily accessible food is ever ready for consumption—struggle to cope with increasing rates of obesity among their populations, the picture is strikingly different in the world's less developed counties, where more than 800 million people are chronically undernourished. Food security—having physical and economic access to enough safe, nutritious food—is inextricably linked with environmental conditions. Weather extremes that impede growing conditions can limit or curtail food production, especially in regions where such conditions persist, and floods can cause rates of food-borne cholera to rise. Weather-related famines are now affecting millions of people in Africa, 12.5 million in Ethiopia alone. The United Nations Food and Agriculture Organization's Special Programme for Food Security (SPFS), located online at <http://www.fao.org/spfs/>, is one effort to help developing countries improve their food security.

The SPFS was begun in 1994 and endorsed at the 1996 World Food Summit, where delegates called for a halving of the number of malnourished people in the world by the year 2015. The program aims to improve



nations' food security through rapid increases in food production and productivity, by reducing year-to-year variability in food production, and by improving people's access to food. The SPFS webpage provides a look at the work done by the program, offering information in Arabic, Chinese, English, French, and Spanish.

The program currently provides assistance in 100 countries, most of which are termed "low-income food deficit countries." The SPFS uses a two-phase approach to introducing new food management methods, described on the Phases and Approaches page. It first provides farmers and others working on the project with the basic essentials—seeds and farming implements—along with training in best practices. Each project has four components, including water control, intensification of crop production systems, diversification of production systems, and analysis and resolution of obstacles. In the second phase, successful approaches are scaled up, and the SPFS works at the national level in member countries to create a nationwide strategy for food security.

Once a community agrees to use a new system, it is adapted, with community input, to best meet the community's needs and take advantage of local resources. For example, a treadle pump developed in Bangladesh is now in use in several other Asian and African countries. This pump, described on the Best Practices page, allows more land to be irrigated with less strenuous labor involved than use of a traditional watering can. The Case Studies page includes a description of how the treadle pump was introduced in Zambia, allowing many farmers to double their growing area and grow new crops, with significant increases in income.

Two of the SPFS regions, Asia and Central America, have sections within the main site. Here visitors can find information on the project work going on in specific countries within each region. Each country page includes geographic and economic overviews, information on training sessions, an outline of how the SPFS was implemented in that country, and a list of technologies developed there. For example, in Bangladesh, the SPFS was involved in developing a new cooking stove that uses less fuel and discharges smoke from the indoor environment, therefore reducing indoor concentrations of hazardous particulate matter. —Erin E. Dooley

Asthma Rising among Chinese Children

The Chinese Ministry of Health announced in May 2004 that the rate of asthma among Beijing children has risen by 1.6

times since 1990. China's rapid urbanization and commercialization, combined with a heavy reliance on coal-burning power plants and less stringent pollution laws, have led to severe air pollution in China's cities. According to the WHO, 7 of the world's 10 most polluted cities are in China. Indoor biomass



burning in rural areas contributes to widespread respiratory diseases among children in those areas as well. The ministry also reports that approximately 20 million people in China suffer from asthma.

Climate of Cooperation

The 47 countries and more than 24 scientific and environmental groups at the April 2004 Earth Observation Summit agreed on a 10-year plan for an international global climate watch system to help scientists assess changes in the Earth's climate, forecast natural disasters, and fight disease. Few details have been released, but the system could bolster support for agreements such as the Kyoto Protocol by pooling data and making them easier for policy makers to access.

The United States—although it has not signed the protocol—supports the monitoring system, which could help the nation save \$1 billion in energy costs annually. Data gathered by the system could also help farmers make better planting decisions and more accurately project market price trends. Delegates will meet again in 2005 to decide on standards and a governing body for the system.

School Utility Report Card

School systems can spend millions each year on energy bills—Florida's Orange County school system, for example, currently spends \$55 million. Because districts often receive one bill for multiple schools, it's hard to know where costs are greatest. So in April 2004, the Department of Energy launched the Utility Report Card, an online program to help school systems reduce their utility bills by tracking, evaluating, and charting energy consumption at individual schools. Developed with the Florida Department



of Environmental Protection, Orange County Public Schools, Progress Energy, and Walt Disney World, the program also teaches students how to be better energy consumers. Orange County's Utility Report Card and contact information for other schools interested in participating is available online at <http://www.utilityreportcards.com/>.